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TITLE: **METHODS FOR PILOTING MOBILE OBJECTS, IN PARTICULAR MINIATURE CARS USING A MULTIPATH GUIDING PROCESS AND SYSTEM USING SAME**

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METHOD FOR PILOTING MOBILE OBJECTS, IN PARTICULAR MINIATURE CARS, USING A MULTIPATH GUIDING PROCESS AND SYSTEM USING SAME

Technical field, problem posed

[0001] The invention concerns a system for controlling mobile objects in a guide circuit. It is particularly applicable, for example, to toy car systems guided on a track.

[0002] Games consisting of automobile circuits in which the cars are guided, for example, by guide lanes, are known in the art. However, these systems generally provide several circuits, each of which guides a car. Each car is guided by commands given to the circuit. If there are several cars on the same circuit, they will be guided in the same way, based on the orders given to the circuit. For the operator, this creates a certain monotony in the use of the system, and in the long run, a certain tedium that can result in a loss of interest in this type of game.

[0003] The subject of the invention is a system that makes it possible to solve this problem. It concerns a system that makes it possible to introduce surprise and spontaneity into the control of a vehicle circuit such as a guided automobile circuit. The invention also has the advantage of making it possible to control several vehicles independently on the same circuit.

[0004] The invention concerns a method for piloting mobile objects driven by actuators, particularly miniature cars, on a continuous track. The mobile objects are guided by operators via a guide circuit comprising several lanes. The guide circuit is common to the various mobile objects moving around the same track. The method comprises the following steps:

[0005] - the step, for the operator, of choosing, ahead of time or in real time, a mobility strategy for the mobile object,

[0006] - the step, for the operator, of parameterizing the mobile object based on the mobility strategy chosen, and/or

[0007] - the step, for the operator, of transmitting to the mobile object control instructions in accordance with the mobility strategy chosen, including control instructions related to its speed and to the guide lane used,

[0008] - the step, for the mobile object, of selecting the guide lane used based on the mobility strategy, as it moves around the track.

[0009] Preferably, according to the invention, the method is such that the mobility strategy is characterized by at least one of the initialization parameters specifying:

[0010] - the type of mobile object,

[0011] - the type of driving,

[0012] - the types and/or quantities of resources available, for example, in the case of miniature cars, the nature of the tires, the initial gasoline allocation, etc.

[0013] The mobility strategy is also characterized by at least one of the following parameters specifying the driving:

[0014] - a speed parameter,

[0015] - a lane change parameter.

[0016] Preferably, according to the invention, the method is such that, in order to parameterize the mobile object based on the mobility strategy chosen, the method also comprises the step, for the operator, of entering data and/or macro commands into a memory area located in the mobile object. The memory area is associated with a microcontroller that controls the actuators.

[0017] Preferably, according to a variant of embodiment of the invention, the method is such that, in order to transmit to the mobile object control instructions in accordance with the mobility strategy chosen, the method comprises the step of initializing each of the mobile objects by assigning them an identifier, particularly an alphanumeric identifier. This identifier can also be characterized by a specific communication channel. In the case of this variant of embodiment, the method also comprises the following steps:

[0018] - the step of formatting the control instructions in the form of digital data by associating them with the identifier of the mobile object in question,

[0019] - the step of multiplexing in the guide circuit the control instructions specific to each of the mobile objects and the electric power supply required to operate the mobile object,

[0020] - the step, for each microcontroller of each mobile object, of extracting from the multiplexed control instructions those that are associated with the identifier that has been assigned to the mobile object in question.

[0021] The method also comprises the step, for the microcontroller, of controlling the actuators based on the extracted control instructions.

[0022] Preferably, according to the invention, the method is such that the multiplexing is a time multiplexing.

[0023] Preferably, according to the invention, the time multiplexing is such that each phase for transmitting the control instructions associated with a given mobile object is followed by a phase for supplying electric power.

[0024] Preferably, according to the invention, the method also comprises the step of supplying power to the actuators of the mobile object through an electrical circuit associated with the guide circuit and/or through a battery and/or through a rechargeable battery in the mobile object. The method is such that, in order to transmit to the mobile object control instructions in accordance with the mobility strategy chosen, the method also comprises the following steps:

[0025] - the step of initializing each of the mobile objects by assigning each of them an identifier, particularly an alphanumeric identifier,

[0026] - the step of formatting the control instructions in the form of digital data by associating them with the identifier of the mobile object in question,

[0027] - the step of transmitting to the mobile objects a signal, particularly an optical – for example infrared – signal and/or a sound signal and/or an electromagnetic signal,

[0028] - the step, for each microcontroller of each mobile object, of extracting from the signal the control instructions associated with the identifier assigned to the mobile object in question.

[0029] The method also comprises the step, for the microcontroller, of controlling the actuators based on the control instructions extracted from the signal.

[0030] Preferably, according to the invention, in order to select the guide lane used based on the mobility strategy, while the mobile object is moving around the track, the method also comprises the following steps:

[0031] - the step, for a given mobile object, of transmitting a guide signal, particularly an optical – for example infrared – signal, to a receiver disposed on the guide circuit and/or on the track;

[0032] - the step, for the receiver, of decoding the guide signal to produce a signal for controlling the state of a switch associated with said receiver and disposed on the guide circuit,

[0033] - the step, for the switch, of changing states as a function of the control signal.

[0034] The result of the combination of the technical features according to the invention is that as the mobile object moves around the track, the mobile object actuates the switch that allows it to change lanes.

[0035] Another result of the combination of the technical features according to the invention is that the operator transmitting control instructions to the mobile object can see that the lateral movements of the mobile object on the track are practically identical to those that would be observed by an observer actuating a steering wheel for changing the direction of said mobile object, whose point of view would be associated with said mobile object.

[0036] Another result of the combination of the technical features according to the invention is that a mobile object moving around the track can pass another one located in front of it, by swerving laterally.

[0037] Preferably, according to the invention, the receiver is disposed on the guide circuit and/or on the track ahead of the switch and at a distance from the latter such that a change in the state of the switch cannot produce a change in the movement of any mobile object other than the one that first actuated the switch.

[0038] Preferably, according to the invention, the method is such that it also comprises the step of automatically switching the switch to a predetermined state after the passage of a mobile object that has actuated it.

[0039] Preferably, according to the invention, the predetermined state is the initial state.

[0040] Preferably, according to the invention, the method also comprises the step of determining the number of laps around the track performed by each mobile object by detecting a label associated with a given mobile object by means of a reader, particularly an optical or electromagnetic reader, integral with the track.

[0041] Preferably, according to the invention, the method also comprises the step of timing the time taken by a given mobile object to perform a given number of laps around the track. The timing is performed by detecting the passage of a label associated with the mobile object read by means of a reader, particularly an optical and/or electromagnetic reader, integral with the track.

System

[0042] The invention also concerns a system for piloting mobile objects driven by actuators, particularly miniature cars, on a continuous track. The mobile objects are guided by operators via a guide circuit comprising several lanes. The guide circuit is common to the various mobile objects moving around the same track. The operator chooses, ahead of time or in real time, a mobility strategy for the mobile object. The system comprises:

[0043] - parameterizing means for parameterizing the mobile object based on the mobility strategy chosen, and/or

[0044] - transmission means for transmitting to the mobile object control instructions in accordance with the mobility strategy chosen, particularly control instructions related to its speed and to the guide lane used.

[0045] Thus, in the example in question, the mobile object can be a robot moving autonomously around the track without the intervention of the operator. It can also be programmed to interpret control instructions from the operator so as to generate movements that correspond to the operator's expectations.

[0046] The mobile object includes selection means for selecting the guide lane used based on the mobility strategy. The selection means are implemented by the mobile object as it moves around the track.

[0047] Preferably, according to the invention, the system is such that the mobility strategy is characterized by one of the following initialization parameters specifying:

[0048] - the type of mobile object,

[0049] - the type of driving,

[0050] - the types and/or quantities of resources available, for example in the case of miniature cars, the nature of the tires, the initial gasoline allocation, etc.

[0051] The mobility strategy is also characterized by at least one of the following parameters specifying the driving:

[0052] - a speed parameter,

[0053] - a lane change parameter.

[0054] Preferably, according to the invention, the system is such that the parameterization means include a control element for entering data and/or macro commands into a memory area located in the mobile object. The memory area is associated with a microcontroller that controls the actuators.

[0055] Preferably, according to the invention, each mobile object is identified by an identifier, particularly an alphanumeric identifier. The system also includes a base comprising:

[0056] - joysticks actuated by the operator in order to acquire control instructions,

[0057] - data processing means for formatting the control instructions in the form of digital data by associating them with the identifier of the mobile object in question,

[0058] - multiplexing means for multiplexing, in the guide circuit, the control instructions specific to each of the mobile objects and the electric power supply required to operate the mobile object.

[0059] Each microcontroller of each mobile object makes it possible to extract from the multiplexed control instructions those that are associated with the identifier that has been assigned to the mobile object in question. The microcontroller controls the actuators based on the extracted control instructions.

[0060] Preferably, according to the invention, the system is such that the multiplexing means perform a time multiplexing of the control instructions with the power supply.

[0061] Preferably, according to the invention, the time multiplexing is such that each phase for transmitting the control instructions associated with a given mobile object is followed by a phase for supplying electric power.

[0062] Preferably, according to another variant of embodiment of the invention, the system also comprises an electric power supply for the actuators, constituted by an electrical circuit associated with the guide circuit and/or by a battery and/or by a rechargeable battery in the mobile object. Each mobile object is identified by an identifier, particularly an alphanumeric identifier. In the case of this variant of embodiment, the system also includes a base comprising:

[0063] - joysticks actuated by the operator in order to acquire control instructions,

[0064] - data processing means for formatting the control instructions in the form of digital data by associating them with the identifier of the mobile object in question,

[0065] - transmission means for transmitting to the mobile objects a signal, particularly an optical – for example infrared – signal and/or a sound signal and/or an electromagnetic signal.

[0066] Each microcontroller of each mobile object makes it possible to extract from the signal the control instructions associated with the identifier assigned to the

mobile object in question. The microcontroller controls the actuators based on the extracted control instructions.

[0067] Preferably, according to the invention, the guide circuit is in the form of several guide lanes. Each mobile object includes a guide element that cooperates with the guide lanes. The guide lanes are interconnected by switches. The mobile object includes transmission means for transmitting a guide signal, particularly an optical – for example infrared – signal, to a switch receiver. The switch receiver, associated with a given switch, is disposed on the guide circuit and/or on the track The switch receiver includes decoding means for decoding the guide signal and producing a control signal for the switch. The switch includes a moving element that is actuated by the switch control signal. This moving element is capable of assuming at least two positions.

[0068] The result of this combination of technical features is that the mobile object can thus select the appropriate guide lane, based on the mobility strategy, as it moves around the track.

[0069] Preferably, according to the invention, the switch receiver is disposed on the guide circuit and/or on the track ahead of the switch and at a distance from the latter such that a change in the position of the moving element of the switch cannot produce a change in the movement of any mobile object other than the one that first actuated the switch.

[0070] Preferably, according to the invention, the system is such that it also comprises return means fòr automatically switching the switch to a predetermined state after the passage of a mobile object that has actuated it.

[0071] Preferably according to the invention, the predetermined state is the initial state.

[0072] Preferably, according to the invention, the system also comprises a label reader, particularly an optical and/or electromagnetic reader, integral with the track, for detecting a label associated with a given mobile object, particularly an optical and/or electromagnetic reader. The label reader is integral with the track. The system also comprises computing means, associated with the label reader, for determining the number of laps around the track performed by each mobile object.

[0073] Preferably, according to the invention, the system also comprises a label reader, particularly an optical and/or electromagnetic reader, integral with the track, for detecting a label associated with a given mobile object. The system also comprises timing

means, associated with the label reader, for timing the time taken by a given mobile object to perform a given number around laps around the track.

Detailed description

[0074] Other characteristics and advantages of the invention will emerge through the reading of the description of variants of embodiment of the invention given as illustrative and nonlimiting examples, and of:

[0075] - Fig. 1, which schematically represents the system according to the invention,

[0076] - Figs. 2a and 2b, which represent an exemplary switch according to the invention,

[0077] - Figs. 3a and 3b, which represent an application of the invention to a system wherein the electric power supply for the vehicles that allows them to move and the speed and guidance information flow through the same circuit, for example the guide circuit for the vehicles,

[0078] - Fig. 4, which represents the control circuits of the system according to the invention,

[0079] - Fig. 5, which represents the circuits provided in each vehicle,

[0080] - Figs. 6a and 6b, which represent a variant of a switch to which the invention can be applied,

[0081] - Figs. 7a and 7b, which represent a variant of a switch that automatically returns to the neutral position.

[0082] Fig. 1 schematically represents the system according to the invention. The system includes a circuit C1, C2, C3 on which mobile objects such as one or more vehicles V1, V2, V3 must run. The circuit C1, C2, C3 is supplied with electric power in an intrinsically known way. For example, in Fig. 1, the power required to move the vehicles V1, V2, V3 is supplied via a transformer T1 and the guide circuit C1, C2, C3. According to the invention, the vehicles V1, V2, V3 also receive speed and trajectory commands through the guide circuit. A circuit interposed between the transformer and the guide circuit is provided, making it possible to transmit, through the guide circuit, speed and guidance information for the vehicles V1, V2, V3. Each vehicle V1, V2, V3 can receive a piece of information, or a packet of information containing a piece of speed information and a piece of guidance control information. The control of each vehicle V2,

V2, V2 is therefore independent of the control of the other vehicles V1, V2, V3 running on the circuit.

[0083] As shown in Figs. 2a and 2b, each vehicle V1, V2, V3 has an information transmitter E1. In addition, the guide circuit C1 has an information receiver D1 associated with each switch A1, A2, A3 and ahead of each switch in the vehicles' direction of travel. When a vehicle receives a guidance command, it has this information transmitted to its transmitter E1. When the transmitter E1 of the vehicle comes near the receiver D1, the latter receives this information, decodes it, and triggers the operation of the switch A1. Thus, in Fig. 2b, the receiver D1 has controlled the switching of the switch A1 so that the vehicle is directed to the lane C3 of the circuit.

[0084] According to a simplified variant of embodiment of the invention, all of the switches on the circuit such as A1 have a neutral position such that after the switching of the switch and after the passage of the vehicle, the switch returns to a neutral position. Under these conditions, the system can be designed so that the normal movement of the vehicle is such that it runs through the circuit with the switches in the neutral position. As long as it does not receive a guidance command, the vehicle's transmitter does not transmit any information, and the detectors such as D1 remain inactive. When the operator wants to make the vehicle turn, for example to the right in Fig. 2a, he sends a direction change command, the transmitter E1 transmits a control signal, the detector D1 detects it and triggers the operation (the switching) of the switch A1, which moves to the position represented in Fig. 2b and automatically returns to the position of Fig. 2a after the vehicle passes.

[0085] Under these conditions, according to this variant of embodiment, the receiver has no decoding function.

Relative position of the transmitters and receivers

[0086] The transmitters such as E1 can be placed underneath the vehicles. In this case, the receivers such as D1 are placed on the circuit in the lane in which the vehicles are running, for example, between the wheel paths.

[0087] The transmitters such as E1 can also be placed on a lateral wall or on the front of the vehicle and oriented toward the edge of the track. The receivers will then be placed on the edge of the track at a height such that they sit on the axis of maximum transmission of the transmission lobe of the vehicles' transmitters.

[0088] In any case, the transmitters E1 will preferably be placed in the front part of the vehicle so as to trigger the switch as soon as possible when the vehicle approaches the switch.

Relative position of the receivers and the switches

[0089] The receivers such as D1 are located along the lane at a distance from the switches A1 such that a vehicle, when it is at the maximum speed allowed by the system, is diverted by the switch A1 that follows the detector D1 right after having been detected by this detector.

[0090] In this general description of the invention, the transmission of the information transmitted from an operator's station to a vehicle can take place through the guide circuits of the vehicle via radio frequency, ultrasound or optical transmission.

[0091] Generally, it is also possible to arrange for the power supply of the vehicle that allows it to move to be provided in the vehicle itself, by means of an electric battery.

[0092] Referring to Fig. 3, we will now describe the application of the invention to a system wherein the electric power supply of the vehicles that allows them to move, and the speed and guidance information, are carried by the same circuit, for example the guide circuit for the vehicles.

[0093] Fig. 3a represents a control diagram for the power supply and the transmission of information wherein the electric power supply of the vehicles is periodically cut off for brief periods, during which the centralized control system transmits guidance and speed information to the vehicles. In Fig. 3a, there are assumed to be three vehicles. During a first electric power supply cutoff, information is transmitted to the vehicle V1 (data V1). During a second electric power supply cutoff, information is transmitted to the vehicle V2 (data V2). During a third electric power supply cutoff, information is transmitted to the vehicle V3 (data V3). Then, the cycle begins again. For example, a time ts for the transmission of data to a vehicle (data V1 or example) can be approximately 5 ms. A time t for the supply of electric power can be approximately 20 ms. A practical example allowing for 8 vehicles would lead to a cycle time T of 200 ms.

[0094] Fig. 3b represents a variant wherein the data V1, V2, V3 of a cycle are sent together during the same cutoff of the electric power supply to the vehicles.

[0095] Fig. 3c represents a variant of embodiment wherein the speed and guidance information are superposed on the power supply current.

[0096] Fig. 4 represents an exemplary embodiment of a control station which supplies the electric power to the guide circuit and from which the vehicles are controlled. The guide circuit in this case includes electrically conductive elements.

[0097] This control station includes a transformer TR which is generally supplied with alternating current by the mains supply and which provides a low-voltage power supply.

[0098] A processing unit UT1 includes a circuit W1 for transmitting speed information and a circuit for transmitting guidance information. These circuits are controlled by joysticks J1, J2, J3 of a known type. The joystick J1 makes it possible to control the vehicle V1, the joystick J2 makes it possible to control the vehicle V2, and the joystick J3 makes it possible to control the vehicle V3. A central control unit UC1 makes it possible to periodically and alternately connect the circuit C1 to the transformer TR and to the processing unit UT1. In addition, the processing unit UT1 controls the successive transmission of the speed and guidance information transmitted from the joysticks J1, J2, J3. It adds to each of these pieces of information an identity (IDENT) that represents the joystick and consequently the vehicle controlled. The successive transmissions take place in accordance with a process of a type similar to the one in Figs. 3a through 3c.

[0099] Fig. 5 represents a vehicle V1. The unit ALIM of the vehicle is connected by an electrical connection device, for example brushes, to the guide circuit. The unit ALIM is therefore supplied with power during the periods when the transformer TR is connected to the guide circuit C1, and it supplies the electric power to the motor M and to all the electronic circuits of the vehicle.

[00100] A processing unit UT2 is also electrically connected to the guide circuit C1 by the brushes. Thus, it receives the speed and guidance information sent by each joystick, along with an identity associated with this information. The processing unit of the vehicle V1 recognizes the identity related to the joystick J1 and hence to itself and retrieves the information associated with this identity.

[00101] The processing unit UT2 processes this information based on the characteristics assigned to this vehicle (for example, parameters such as the driving type, the vehicle type, the speed, the nature of the tires, the gasoline allocation, etc.) and then transmits the processed speed and guidance information. A control unit UC2 provides:

[00102] - a piece of guidance information to a transmission circuit G for activating the transmission by the transmitter E1 of a piece of guidance information

[00103] - a piece of speed information to a transmission circuit W2 for controlling the speed of the motor M.

[00104] On the guide circuit end, a receiver D1 is located along the circuit. When the receiver D1 receives a piece of guidance information as a vehicle passes, it switches the position of the switch A1, particularly by means of an electromagnet.

[00105] In a simplified version, each switch has only two positions as in Fig. 2a. In this case, the guidance information is just a simple piece of switching information, which is all the receiver D1 needs to detect in order to trigger the switching of A1.

[00106] In a more elaborate version, a switch can have more than two positions and can switch a lane C1 to more than two possible other lanes.

[00107] For example, Figs. 6a and 6b show that a lane C1 can be connected to a selected lane C2, C3 or C4. In this case, the guidance information transmitted by the transmitter E1 contains a direction indication and must be interpreted by the receiver D1.

[00108] In this case, the transmitter E1 includes several light sources such as diodes. A combination of lit diodes makes it possible to represent a control instruction. Thus, two diodes make it possible to control a four-way switch, and three diodes make it possible to control an eight-way switch. Then, based on the guidance information received, the control unit UC2 will then actuate the lighting of selected diodes that correspond to this information.

[00109] Each receiver such as D1 will have as many detecting diodes as each vehicle has emitting diodes. Based on the diodes that have detected a signal, the receiver D1 will control the position of the switch.

[00110] It should be noted that the transmitters on the vehicles must be positioned based on the position of the detectors, and vice versa, so that as the vehicle passes, the various diodes of E1 pass in front of the diodes in the same row of D1.

[00111] In the above system, it is presumed that in the absence of a detection of a guidance information signal, the switch is not activated, and it remains in the neutral position like the one in Fig. 2a.

[00112] Figs. 7a and 7b represent a device that makes it possible to have the switch return to the neutral position after a vehicle passes.

[00113] In Fig. 7a, the switch A1 is in the neutral position, and it connects the lane segment C1 to the lane segment C2.

[00114] Switching the switch A1 has the effect of connecting the lane segment C1 to the lane segment C2. The point of the switch A1 has a portion B1 that curves toward the inside of the lane segment C3.

[00115] When the vehicle that triggered this switching passes over the switch, it pushes on the portion B1 and forces the switch to return to its neutral position.

[00116] It should be noted that depending on the type of switch, the switching of the switch can be done by means of a keel Q located underneath the vehicle and extending downward into the support plate containing the guide system. In this case the part B1 does not interfere with the passage of the vehicle's wheels.

[00117] Preferably, it is arranged for the keel to be located underneath the vehicle at the front of the vehicle in order to trigger the return of the switch to the neutral position immediately after it passes.

[00118] Moreover, each vehicle has, underneath the vehicle, an identification label L. This label is optically, electrically, or electromagnetically readable by a sensor CL located along the guide circuit. This sensor is linked to the processing unit UT1, which can thus calculate the various performances reached by the vehicle, such as speed, distance traveled, etc.

[00119] In the above description, we chose to describe an application of the invention to a system of cars guided by an operator but it would also be applicable to a system comprising preprogrammed robot cars.